SMART SECURITY SYSTEM FOR HOME ON (IoT)

MUHAMED OBED ABD OUN

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DEDICATION

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ABSTRACT

This research project is about security home system with IoT. The project will uses Arduino UNO microcontroller as a core component integrated all the sensors, process the sensors' signals and transmit the signals to the WiFi module. At the receiver, there will be one platform or Apps designed to display the signals. Typical signals are the alarm activation ON and OFF signal. Two sensors will be used. One is step switch sensor and second one is ultrasonic sensor. The step switch sensor is used to detect an intruder break in the house through door or window whereas the ultrasonic sensor is used to detect to a mobile intruder around the building campus. These sensors' signals are digital. They are first process inside the microcontroller. By uisng ESP8266 WiFi module, the sensors' signals will be send over an internet network. At the end of the project, a small prototype security system based on IoT will be developed.

Keywords: IoT, security, Internet, WiFi, Apps and Arduino microcontroller.

ABSTRAK

Dalam Projek penyelidikan ini adalah mengenai sistem keselamatan rush dengan IoT. Projek ini akan menggunakan mikrokontroler Arduino UNO sebagai komponen utama yang menggabungkan semua sensor, memproses isyarat sensor dan menghantar isyarat ke modul WiFi. Untuk penerima, akan ada satu platform atau Apps yang direka untuk memaparkan isyarat. Isyarat tipikal adalah pengaktifan penggera ON dan isyarat OFF. Dua sensor akan digunakan. Pertama adalah langkah suis sensor dan kedua adalah sensor ultrasonik. Sensor suis langkah digunakan untuk mengesan penceroboh yang hendak memasuki rumah melalui pintu atau tingkap manakala sensor fultrasonik digunakan untuk mengesan kepada penceroboh yang berada di sekitar bangunan kampus. Isyarat sensor ini adalah digital. Ia adalah proses pertama di dalam mirocontroller. Dengan mengunakan modul Wi-Fi ESP8266, isyarat sensor akan dihantar melalui rangkaian internet. Pada akhir projek, sistem keselamatan prototaip kecil berdasarkan IoT akan dibangunkan.

Kata kunci: IOT, keselamatan, Internet, WiFi, Apps dan mikrokontroler Arduino

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LIST OF SYMBOLS AND ABBREVIATIONS

IoT	**Internet of Things**
GUI	Graphical User Internet
PIR	Passive InfraRed sensor
IR	Infrared
I/O	Input/ Output
Tx	Transmitter
RX	Receiver
GSM	Global System Mobile
GPS	Global Positioning System
WSN	Wireless Sensor Node
RSS	Received Signal Strength
MAC	Media Access Control
IP	Internet Protocol
NDN	Named Data Networking
LOS	Line of Sight
TDD	Time Division Duplex
FDD	Frequency Division Duplex
SIM	Subscriber Identity Module

MIT	MagicTrick
ID	Identification

CHAPTER 1

INTRODUCTION

1.1 Introduction

Smart home system and security now becomes big discussion to enhance human living status. Everyone aims to live comfortable with minimum works at home. Everyone also seeks to look for convenient when steps into a house. In this century, it is notice that technology plays an important roles to guide human live into next level. The next level is a higher level where human will depends solely on the machines and systems to guide them in any activities. For example, when a person goes to sleep, he or she hopes that the room's light can be automatic switch ON and OFF at the desire time and level. A person also hope that the fan and air conditioner at home can turn ON and OFF automatically to save energy or when it is necessary [1-5].

The terms 'smart home' system is refers to three important items. These items are automation, control and surveillance or security system. Anything can works independent from human control is called automation. For example, when a person step in the house, the light will turn ON and when that person step out the house, the light will turn off automatically. The light automatic turn ON and OFF has a meaning of automation. For automation, sensors are needed. Various sensors like infrared sensor, ultrasonic sensor, temperature sensor, sound sensor and so on can be used in the home automation system. As long as there is one controller in the system incorporate with sensors, the whole appliances at home will be turned into automation control[4-8]. For

the control in smart home system, it is refers to manual control and automatic control. Manual control doesn't means the system is using one traditional controller with one receiver. In fact, it is using smart phone to control via a Bluetooth link or Wi-Fi link [9-11]. For the security, it is refers to protection of user's asset in a building. The best security system is an alarm. The alarm provides smart security system where it has a sensor. Once the intruder breaks in the house and activate the sensor, the alarm will sound. For smart security system, the alarm not only sound but also sending information to the house owner. The information send is a video or picture information where the image of the intruder is send via an internet network and reach the smart phone or computer of the house owner [10-12].

In this project, a smart home and security system is proposed using Arduino microcontroller and Blynk Apps. The proposed system comprises of sensors that can detects the commotion in a room. If there is a mobile object or illegal break in, the system will automatically send an alert signal to the user's smart phone via an internet connection. At the same time, user also can control the home appliances such as light, fan and air conditioner using the same apps that detects an intruder. For surveillance system, the apps will have a small portion for user to view the video signal send from the video camera.

The main components in the proposed smart home and security using IoT are:

a) Arduino microcontroller
b) ESP8266 WiFi chip
c) Blynk Apps

Other thing to be added on is the viewing the sensor signals using html platform. This platform is developed using thingspeak.com page. By design a proper GUI (Graphical User Internet), all the sensor signals can be displayed in the platform via an internet signals.

1.2 Problem Statement

IoT becomes more and more popular nowadays. Moving to 21 century, everyone is aims for convenient and comfortable life. Today there are many IoT products which can help to make user life easy. All these products can connect to the user mobile phone via internet facility. With suitable apps come along with the products, this even make the system more easily control and enhance the security. Although the current IoT products and systems are very stable, but they have two drawbacks. One is very costly and second is, no freedom to customize the GUI.

The cost of existing IoT products and system installation are very expensive, typical products are professional products added with enhance security system. Most of these products can control heavy loads that are running high current and high power. Not every user has afford to buy such products. Therefore, cost is one of the key issue or problem with current IoT system. The current professional IoT system and products also not allow user simply modify the apps and graphical contents in the apps. Hence, if user wants to customize the apps to become another look, then the current IoT system will not allow to do that. For the IoT system that proposed in this project, it allows user to modify the apps appearances. Thus, users can have freedom to design and modify the apps according to their wish.

1.3 Objectives

The objectives of this project are:

I. To design a smart securety system for home.

II. To develop and impelement the system using IoT technology.

III. To do analysis and check the functionality of sensors signals on the mobile platform.

1.4 Scope of the Project

To meet the objectives, there are few topics have to focus and study in detail. These topics are:

I. To Learning the Arduino C programming and focus on the design of the program that can detect sensor's signal, process the signal and send the signal to the ESP8266 WiFi chip. At the same time, the system also be able to receive the control signal, interpret the signal and control the loads according.

II. Learn the ESP8266 WiFi chip.

III. Study the ultrasonic and switch sensor characteristics.

IV. Learn the apps design using Blynk.

V. Learn the html platform design using Thingspeak.com

Overall, the programming is the first component to be studied and learned in this project. Programming is difficult learn and taking much time to configure and debug. Therefore, the overall project time will spend more in the programming.

Besides programming, there is a need to know the ESP8266 WiFi chip, ultrasonic sensor and switch sensor. The ESP8266 is a tiny WiFi module. Its function is to provide an internet coverage and form a communication between microcontroller and the wireless nodes in the network. ESP8266 is not easy to learn. There is a need of firmware update when first time use. Also, user must understand the types of ESP8266 modules. Some can operate in 5 V and some operates in 3.5 V. The last two things have to focus

are the apps and page design. To make the things quickly done and connect to the internet network, Blynk apps platform is selected. This apps is free and can be downloaded from internet. The Blynk allows user to design any apps he or she like. Thus gives convenient for user to modify the content if needed.

For the pages, the Thingspeak.com is a platform for user to design a page that can detects incoming sensor signals from the microcontroller and plot graphs. Thingspeak.com is an open source apps and free to download. The advantage of this platform not only allows user to design a page but it also has a capability to save the user data.

1.5 Significant and Contribution

The significant of this proposed project are:

1. Giving a free hand to modify the apps that can control appliances and monitor the house conditions.
2. Low in cost.
3. Stable operations.

The project can be contributed to the low cost and basic IoT system for smart home. Although there is a limitation for the proposed project, but the general idea and concept can leads to the next upgrade level of the whole projects.

The project also can provides contribution to the education, especially in the IoT system research. With this idea and concept, students will learn the basic IoT and wireless control of devices via internet signal.

1.6 Summary

In general, the smart home and security system is about the automation, control and monitoring the house conditions. The term 'smart' refers to automation and application

of cutting edge technology. For the basic IoT requirements, there must be a sensor, microcontroller, internet module, apps and html page. The sensor will senses the signals and send the signals to the microcontroller. The microcontroller process the signals and then route the signals to the WiFi module. The WiFi transmits the signals over internet network. To get the signals, user must have a receive platform like apps and internet page. These platform allows user manage the signals and control the appliances from far distance wirelessly.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will show the theoretical reviews on the security system in a smart house. The reviews will look into traditional security systems, technology and slowly introduces the new technology on the security and automation. The chapter also reviews some of the conference papers or journals that related to this research. It is very important to review the papers because this can help us to know the development of the technology related to the smart house. The chapter ends with the summary to highlight important notes that should be reminded when carry the practical sections.

2.2 Reviews on the Current Security System and Automations

In Security is important to protect the asset or properties in a building. Today, there are two main security systems that can be applied to protect the properties inside a building. One is using mechanical way of security system and second one is using electronic way [8-12]. The mechanical way is using padlock, mechanical locking system and other hard container to lock the valuable things and protect them. Mechanical way is a very simple security system to protect the asset. It requires a key or a mechanical password to lock or unlock the properties.

In terms of cost, mechanical way of protection or security system is the most economical one.

The security system also can be enhanced using electronic way. The electronic security system is using alarm, sensors, control board and speaker. The sensors are used to detect the mobile object around the campus. The sensors trigger the control board when detect an object. The control board consists of microcontroller that makes decision to activate the alarm or speaker. Once the alarm is triggered, a loud sound will be produced to alert the owner about someone had break into the building. The security system using electronic way is very complicated and the design is very difficult compare with the one using mechanical. Until today, still there are many people using traditional alarm system to protect their properties in the house. The alarm they used are simple digital circuits. The circuits attached to the sensors and consist of many logic gate functions. Once the sensor sending information to the circuits, the circuits will make decision to trigger the alarm [14-16].

A more advanced types of security system can found is using microcontroller technology. The microcontroller is a programmable device. With this technology, complicated traditional alarm circuit systems can be simplified and reduced to less number of components. Also, the circuit size can drastically reduce. Microcontroller alarm system or security system is preferred by many people. This technology allows user change the configuration of the system design without modify the hardware. Unlike the traditional types of digital security system, the circuit has to change if the new configuration is setup. A slightly more advanced type of security system is using wireless technology. This technology still using microcontroller but add with wireless transceiver circuit.

A wireless security system allows the alarm signals to be send into an internet network. At the receiver, the user can download an Apps or pages to determine his or her house status. Hence, this kind of wireless technology involve internet network is called IoT (Internet of Thing) technology. Today, IoT security becomes very popular in protecting the assets in a building. It helps to send the sensor signals to the internet network, allow user to view the signals and saved the signals into the network. IoT also

control the building electrical appliances. This can be done via through processes. One is using internet page to control. Second is using Apps to control. The former requires GUI to be developed in Java code in order to control the electrical appliances. The Java code used in the programming should precisely determine the location of the appliances in a building. Once the location know, then the control signals can be send through the network and control the appliances [13].

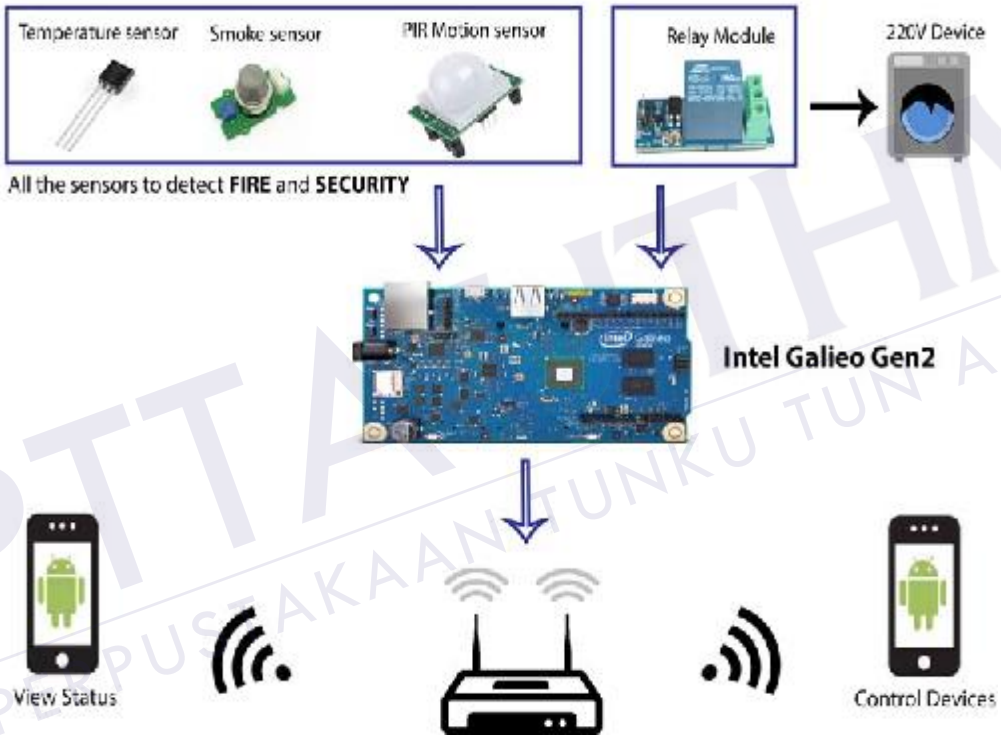


Figure 2.1**:** Security system based on IoT [15]

Figure 2.1 illustrates the current security system using IoT technology. Notice that the sensors like PIR, IR, ultrasonic sensor and magnetic sensor are the key sensors used in security system. These sensors are installed in a building to detect a mobile object around the compound in the building. Once the mobile object is detected, the

sensor will send the signal to the Intel Galieo Gen 2. The Intel Galieo Gen 2 is a microcontroller that has build in WiFi. The microcontroller process the sensor signals and then send the signals to the gateway. Notice that the Intel Galieo allows multiple users to detect the sensor signals via an Apps. This means that more than one user will receive the alert signal at the same time once the sensor senses and object [16].

The Apps are Android. It is designed to show the parts in a building where the sensor has been activated. At the same time, the Intel Galieo also trigger the alarm to chase away the intruder. The alarm continue to sound until it is deactivated by the user via Apps control.

2.3 Basic Components Required for Security System Based on IoT Technology

To build a security system based on IoT, the components play an important role. For a basic security system, one should have the sensors, microcontroller, WiFi unit, gateway, internet network, Apps or platform to store the sensor data.

2.3.1 Sensors

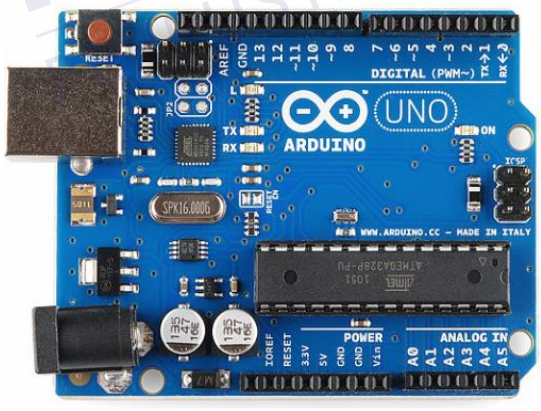
The sensors are the basic components that should be the upfront in the security system. The sensors like ultrasonic sensor used to detect the mobile object at a distance. The sensor transmits a sound that will be reflected by an object. The reflected sound is then captured by the receiver and the receiver will process the signal to trigger the alarm or send the signals to the internet network via a gateway[14-16].

Apart from using the sound, the light also can be used to detect a mobile object and enhance the security system. The light sensor like infrared sensor and PIR sensor use the light to detect an object. The distance travelled by the light can be adjusted through the sensitivity adjustment. The light has a disadvantage that when there is a mobile object hiding in a static object, the light could not effectively detect such mobile object. Thus, ultrasonic or sound sensor is the best sensor used in the security system.

Another type of sensor like video camera sensors also can be used to detect the mobile object and send the alert signal. It is not necessary has to send the picture signal or video signal over the internet network so that people can view it in the Apps or using the webpage. The system can send the alert signal to save the bandwidth in the IoT system. As long as the microcontroller process the signal and found that if it is really a mobile object, then the microcontroller will trigger the WiFi to send the alert signal. Other sensor like touch or magnetic sensor also commonly used by people to enhance the security system. Magnetic sensor usually placed at the door or window. When people open the door or window, the sensor loss the magnetic contact and hence causes the voltage or current change. By using this concept, the system is able to know there is someone break into the house via a door or a window [14-22].

2.3.2 Microcontroller

Microcontroller is programmable device. All microcontrollers can be used for IoT purposes. Below shows few modern microcontrollers that can support the IoT.



(a) Arduino UNO

(b) Raspberry Pi

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